



Mincom's PD-1000

This advanced Mincom Parallel PCM Recorder/Reproducer is designed to take full advantage of the simple and reliable data-handling capability inherent in digital transmission, recording and playback. Information is conveyed by the time relationship between only two levels—zero and one—and noise is reduced to a minimum through the use of narrow-band parallel digital record/reproduce techniques. PD-1000's standard packing density is 1000 bits per inch per track. □ The PD-1000 provides twelve PCM NRZI channels on one-inch tape with one spare track, two NRZ time-code tracks and one clock pulse track. One channel of audio record and playback electronics is standard, with an extra audio track available. □ The entire system is mounted in a single standard rack. This includes a high quality test oscilloscope modified to monitor data, clock and time-code information, representing all sixteen tracks simultaneously on the screen in their true time relationship. Signal electronics circuitry conditions the data and provides sweep, intensity and trace-level information to the oscilloscope. While monitoring, a simple read head azimuth adjustment aligns all channels in one operation and eliminates the need for individual track alignment.

Features

Maximum data transfer rate: 120,000 bits per second at 120 ips

Sixteen channels on 1-inch tape

Complete front-accessible operation

Seven speeds: 1½, 3¼, 7½, 15, 30, 60 and 120 ips

10½ or 14-inch NAB standard or precision reels

All solid state signal electronics

Reliable DC Top Plate

Push-button mode and speed controls. No belt changes

Dynamic braking

All-metal-front magnetic heads

Mincom Isolooop® provides positive tape-to-head contact, isolates tight loop from common sources of flutter

Optional remote control



Straightforward functional design of the PD-1000 is apparent in the illustration above, with dust door open to show detail. At the top of the rack is the oscilloscope monitor display, with signal electronics control and a sixteen-channel read strobe position selector at the right, and scope adjustment controls at the left.

Below the scope panel is the Mincom DC tape transport with backlighted mode selectors and seven speed buttons.

The module at the right under the top plate is the electronics power supply. At left, extending to the bottom of the rack, is the signal electronics slide-mounted sub-assembly. At the top of this drawer are the pull-out microphone, speaker, audio playback volume control and jack for headphone. Below the audio controls is an array of indicator lights showing the state of various flip-flops in the signal electronics for maintenance and circuit monitoring.

The PD-1000's Direct Approach to the parallel digital format is shown in the accompanying block diagrams. In Figure 1, incoming signals are conditioned for recording by the write electronics. This data input for any signal track may be a level logic signal of "zeros" and "ones" corresponding respectively to 0 vdc and $+10 \text{ vdc} \pm 5 \text{ vdc}$. A level converter provides uniform data levels of 0 vdc and $+4 \text{ vdc}$ through the remainder of the electronic flow. These signals are applied to an AND/OR gate in both direct and inverted states; this gate can then be programmed manually to pass the direct or inverted data depending upon required input polarity relationships. Data then enters a flip-flop complemented by a clock pulse; each time the flip-flop changes state, at clock times, when input signal is a logical "one," the write amplifier changes the flux polarity to the write head through a reversal saturation technique (NRZI) changing the flux 180 degrees for each logical "one."

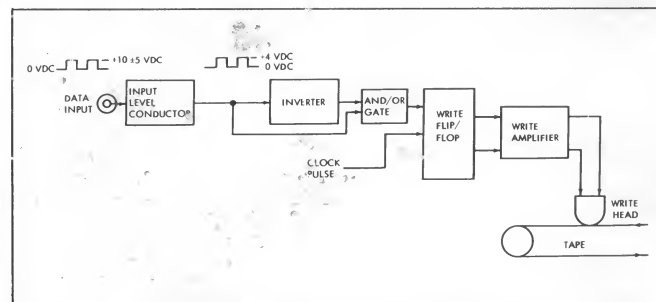


Figure 1. NRZI Data Track Write Electronics

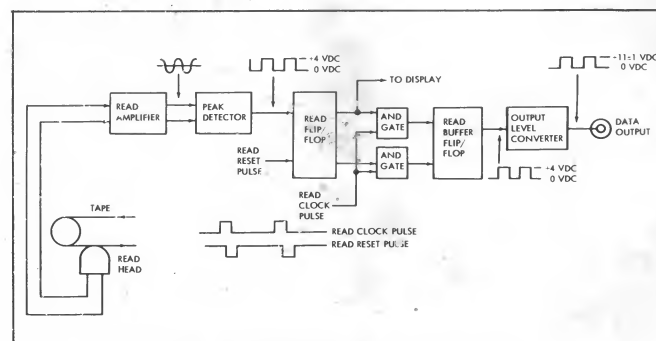


Figure 2. Data Track Read Electronics

In the read mode (Figure 2), the saturation flux reversals are sensed by the read head and proceed to the read amplifier. The read head is sensitive only to rate-of-change of flux and produces its output in a differentiated wave form as shown in the diagram. In the peak detector the data is returned to its proper time relationships and is applied to the "set" input of a read flip-flop, then to a read buffer flip-flop every time a read strobe pulse is generated. The output from the read buffer flip-flop is now representative of the original recorded (write) signal and regains its previous values in the output level converter prior to final read data evaluation.



Accessibility of subsystems for operation, adjustment and maintenance is an outstanding design feature in PD-1000. All key points are on the recorder's front surface and the rack may be located within a few inches of the installation's wall if required, using a minimum of floor space.

In the illustration at left, the pull-out drawer housing the complete signal electronics subassembly is shown extended on its slide chassis. It comprises approximately seventy-three circuit boards of sixteen different types, according to options and required modifications. In this group are included the conversion and digital logic electronics for driving the write heads and for recovering data from the read heads. This circuitry drawer also holds the conversion and drive circuits for the monitor display oscilloscope and the record/reproduce electronics for the audio annotation system. The indicator lamp panel for quick-look inspection of the circuitry operation has been noted on the preceding page.

Completely IRIG-compatible, PD-1000 is built with the same reliability and quality engineering that have typified Mincom instrumentation systems for the past ten years.

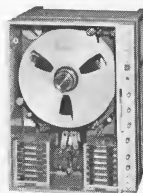
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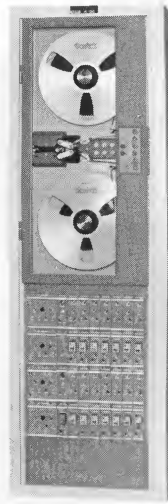
TICOR II



TIDAX



PC-500



H-100

TICOR II, reducing time displacement error to $\pm 0.5 \mu\text{sec}$, increases data analysis capability by a factor of 1000. TIDAX is a new approach to housing fourteen 1.5-mc tracks in one standard rack. PC-500, portable coaxial, records fourteen 1.5-mc channels, occupies less than four cubic feet and weighs under 130 lbs. H-100 is a general-purpose, intermediate-range recorder: Direct 100 cps to 300 KC, FM DC to 20 KC.

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MINCOM PD-1000 RECORDER/REPRODUCER

SPECIFICATIONS

TAPE TRANSPORT

Tape Speeds: 120, 60, 30, 15, $7\frac{1}{2}$, 3-3/4 and 1-7/8 ips.
All speeds electrically switched by depressing proper speed selector button.

Reel Size: $10\frac{1}{2}$ " or 14" with NAB hubs containing 1 inch wide magnetic tape.

Start and Stop Time: Stable tape motion shall be achieved in either the record or reproduce mode within 8 seconds at 120 ips. Stop time, less than 2 seconds from Run to Stop at any speed.

Braking: Dynamic braking used in all modes.

Fail Safe System: A fail safe system shall provide dynamic braking of the tape drive mechanism in the event of power failure.

Tape Speed Timing Accuracy: Within 0.15% for either the record or reproduce modes.

Rewind Time: 6 minutes for a 9200 foot, 14 inch reel of 1 inch tape.

MAGNETIC HEADS

Construction: The magnetic head stacks shall be rigid, block-type, precision ground and lapped, all metal front surface units. The track number, width and spacing shall be in accordance with IRIG Document No. 106-60. Each head set shall be removable and replaceable within IRIG tolerances without shimming or alignment.

Track Dimensions: (16 Track System) 16 tracks per inch, track width $0.025" \pm 0.002"$, and track spacing 0.060" on center.

INTER-CHANNEL TIME DISPLACEMENT

The Pulse Position Monitor shall be an oscilloscope which uses a 5 inch CRT to display the time displacement of the output of all data tracks, and the

PCM clock simultaneously to show the amount of actual time displacement due to static and dynamic skew. No time delay circuits shall be used in the reproduce data circuitry. Time delay circuits shall only be used in the reproduce monitor circuits to maintain this display as a true indication of the amount of time displacement.

Correction for time displacement shall be accomplished by using a 16 position Reproduce Strobe Position Selector switch to select the proper skew clock pulse within the range of the data pulses. This pulse then strobes the data out of the read buffer into the output buffer. The reproduce head azimuth is then adjusted for minimum time displacement. These static time displacement corrections shall only be made once for each tape at any one tape speed. The skew logic is such that correct operation is maintained at all other tape speeds.

RECORD/REPRODUCE SYSTEM

Data Format:

Data	Input Format	Record Format	Output Format	Standard number* of Channels
PCM	NRZ Change	NRZ Mark	NRZ Change	12
Clock	Level Change	NRZ Mark	Level Change	1
Timing	NRZ Change	NRZ Change	NRZ Change	2
Voice	Microphone	Direct	Audio	1

*If timing channels are not used, 14 data channels can be used with 1 clock channel and 1 audio channel, or 15 data channels with 1 clock, and A and B audio channels.

Maximum Data Transfer Rate:

Maximum data transfer rate shall be 120,000 bits per track per second at 120 ips. At lower tape speeds maximum transfer rate shall be proportionally lower.

Input Level:

Input level shall be PCM - Binary "Zero" 0 volts + 0.5 volts, -10.0 volts Binary "One" + 10 volts $\pm$ 5.0 volts. Above inputs shall be manually switched on the front panel to: PCM - Binary "Zero" + 10 volts $\pm$ 5.0 volts. Binary "One" 0 volts + 0.5 volts -10.0 volts.

Input Impedance:

Input impedance shall be 10 K ohms in parallel with 100 PF.

Output Level:

Output level shall be PCM, Time Code (NRZ), and clock - Binary "One" 0 volts -0.5 volts. Binary "Zero" $\pm$ 11 volts $\pm$ 1 volt. Above outputs shall be manually switched on the front panel to: PCM - Binary "One" + 11 volts $\pm$ 1 volt. Binary "Zero" 0 volts -0.5 volts.

PCM data and Time Code (NRZ) outputs shall be individually switchable. Maximum cable capacitance shall be 2400 PF.

Output Impedance:	Output impedance shall be nominal 100 ohms at either logic level.
Output Rise and Fall Time:	Output rise and fall time shall be 1 microsecond or less.
Clock Channel Jitter:	Clock channel jitter shall be ± 0.7 microseconds or less at 120 ips, proportional at lower tape speeds.

GENERAL

Environment:	The equipment shall meet or exceed its specifications when operated in an ambient temperature range from 40° to 125° F with relative humidity up to 98% without condensation and a barometric pressure from 30 to 20.6 inches Hg.
Equipment Enclosures:	The equipment cabinet shall be of rigid, dust resistant, welded steel construction having the following maximum dimensions: Height - 77½ inches, Width - 23 inches, Depth - 24 inches.

The above specifications are met when operating at 117 volt 60 cycle nominal AC line power.

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Mincom Portable Coaxial Recorder
highest performance per cubic foot

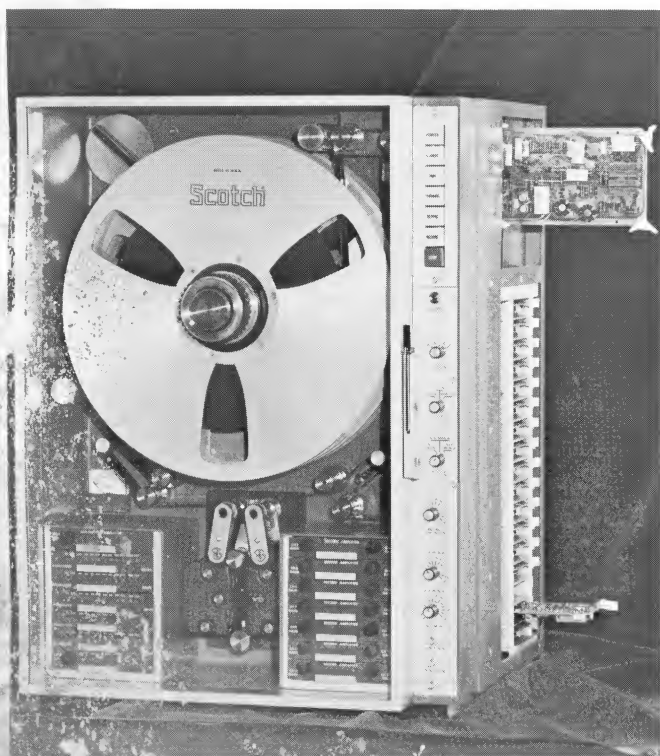
Mincom Division **3M** COMPANY

Mincom's PC-500

This beautifully designed and superbly engineered compact 1.5 mc recorder is telemetry's most advanced solution for the problem of extreme wideband multi-channel performance in a limited package. Intended primarily for data acquisition in any type of field installation, it is equal to all and superior to many standard-rack wideband recorders now in similar use — even when small size (less than four cubic feet) is not a requirement. □ Mincom's PC-500 Coaxial Reel Recorder is compatible with all standard playback systems, including the Mincom TIDAX and TICOR II. By generating a standard 200-kc reference signal during the record process, advantage can be taken of TICOR II's unequalled time comparison between events ($\pm 0.5 \mu\text{sec}$ compared to reference track) when reproduced. □ The PC-500 was designed with the problems of the field operator in mind. An easily attached slide mount enables the system to be housed in a standard rack. The recorder is quiet, and RFI-shielded. □ Quick-look monitoring is provided by two nominally equalized playback channels, switchable to any of the fourteen record tracks, enabling the operator to check signal quality and to observe the recorder's overall performance. □ For shipboard, van, airborne and other demanding and unusual installations, the PC-500 is the most efficient and versatile 1.5-mc system on the market today.

Features

- 400 cps to 1.5 megacycle bandwidth
- Seven or fourteen record tracks
- Two reproduce/monitor channels
- 10%, 12½ or 14-inch NAB standard or precision reels
- Compact package: 23" high, 17½" wide, 16" deep
- Lightweight: Less than 130 lb. for 14 channel
- Seven recording speeds, 1½ to 120 ips, in three ranges
- Completely solid state modular construction
- Longer recording time: From 15 minutes at 120 ips to 8 hours at 3¾ or 16 hours at 1½
- Dynamic braking, with mechanical fail-safe braking
- Push-button mode and speed controls. No Latch changes
- Mincom Isoloop® provides positive tape-to-head contact, isolates tight loop from common sources of flutter
- Optional remote control

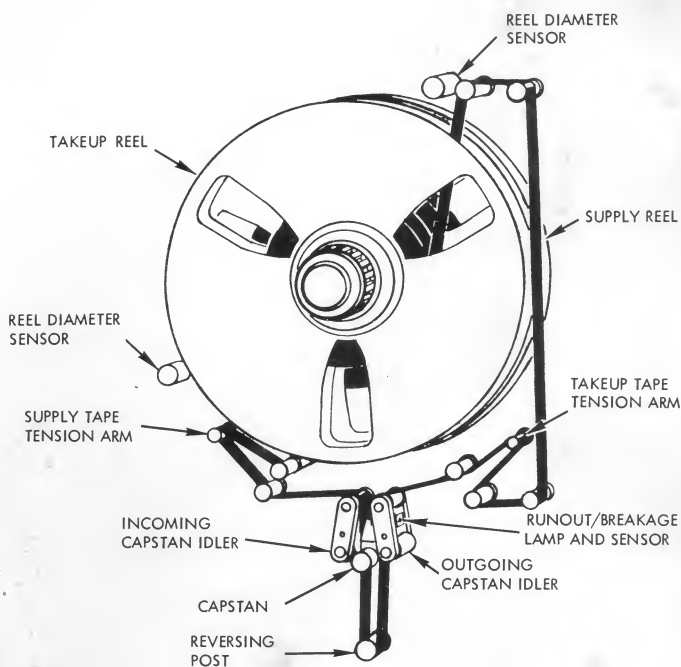


All Solid State modular assembly is maintained throughout Mincom's PC-500. In photograph above, system is shown with the transport speed-control circuit extended (top) and a record driver PC card extended (below). On the front control panel are shown, from top, back-lighted mode push-buttons for Power, Standby, Run, Fast Forward, Rewind, Record and Stop. Below the mode controls: Tape tension release button, speed selector switch, local and remote control switch, record and reproduce monitor switches. Signal electronics shown in illustration below are (left) two record output amplifiers and five speed equalizers; (right): Seven

record amplifiers handling fourteen 1.5-mc channels. Above the speed equalizer bank a VU meter provides signal level monitoring for single-channel record or reproduce.

The Tape Transport uses a new Mincom basic design for the most precise control of coaxial reel movement with respect to the tape's geometrical path, tension and rate. All transport circuitry is solid-state. Supply and takeup reels are stack-mounted on a single hub, and are coaxially driven by individual motors which rotate their respective reels through an approximate five-to-one ratio to attain sufficient torque for positive control of full tape reels.

Both reels are equipped with light-beam diameter-sensors which send transfer, stop and/or reversing commands to the recorder's function control subsystem in response to a preset tape diameter indicating quantity on the reels.

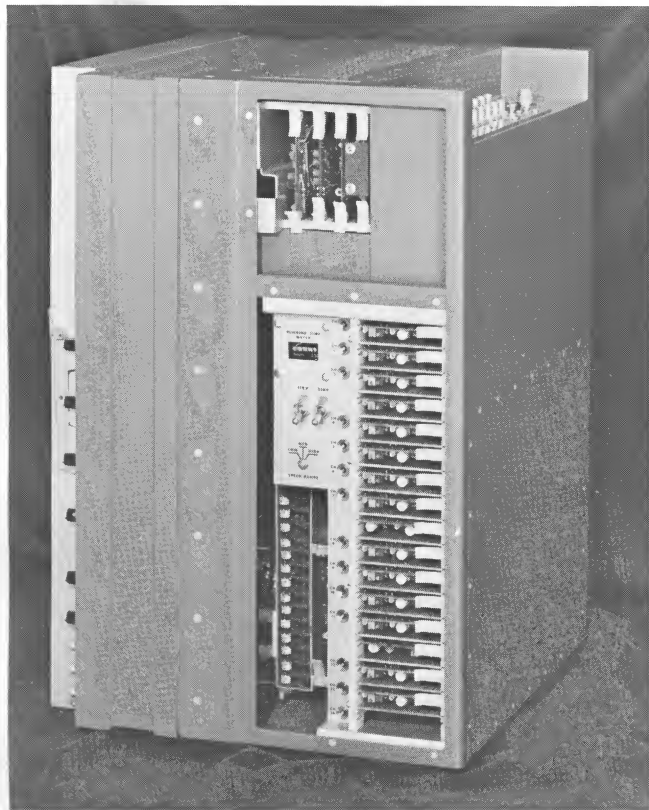


The supply and takeup sensor arms (see diagram) function as controlling inputs to the reel servo assemblies.

In the record and reproduce monitor modes, that portion of the tape passing over the heads is isolated and held in constant optimum operating tension by Mincom's exclusive Isolooop drive. Isolooop has been well known since 1957 for its reliable performance in maintaining head-to-tape contact.

The transport utilizes the simple and reliable high-performance concept of Mincom's exclusive DC Top Plate to provide the same dependable simplicity in the coaxial configuration.





Accessibility of certain important connections, major subsystems and adjustments is shown in illustration at left. The connector panel is recessed in the recorder's top surface and includes connections for signal input (14 channels), remote control, control track, output reproduction (14 channels), AC line power, RFI filter and record/reproduce monitoring jacks.

In the upper side panel are shown the transport speed control circuits. In the panel below, record driver boards are at the right. At the left, from top to bottom: Running time meter; two voltage selector switches for various AC inputs; a three-position speed-range selector, and record pre-amplifiers. Extending from top to bottom of this panel are bias adjustment potentiometers for fourteen record and two reproduce-monitor channels.

Optional Circuitry for the Portable Coaxial Recorder includes a remote control accessory enabling the operator to activate the Record, Run, Rewind, Fast Forward and Stop modes.

Maintenance and reliability: The recorder's assemblies and circuits are designed for extended service under the varying conditions normally encountered in the field.

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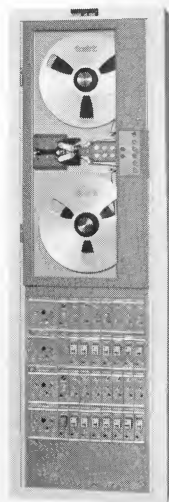
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MINCOM PC-500 MAGNETIC TAPE RECORDER/REPRODUCER

GENERAL SPECIFICATIONS

Power Requirements: 115 or 230 volts, $\pm 10\%$, single phase ac, 60 cps $\pm 10\%$, or 400 cps $\pm 10\%$. Less than 500 w average for any mode of operation (complete 14-channel system).

Size and Weight: The complete 7 or 14 channel recorder-reproducer system, with power supply for 7 or 14 amplifiers, tape speed control servo and tape transport, shall be contained in one cabinet, 24 x 17-3/4 x 16 inches.

Maximum weight: 130 lbs.

Ambient Temperature Range:

Operating: 0° to 50° C
Non operating: -30° to 80° C

TAPE TRANSPORT

All transport specifications stated using 14" Precision reels ($\frac{1}{2}$ " or 1", and 3M type 951 tape).

Tape Speed: Choice of three ranges, each with five adjacent electrically selectable speeds, covering a range of 1-7/8 to 120 ips.

Speed Accuracy: $\pm 0.15\%$ standard.

Tape Type: Polyester base, 1.0 mil (3M type 951, or equivalent recommended).

Reel Capacity: Precision or standard 14", 12 $\frac{1}{2}$ " or 10 $\frac{1}{2}$ " with NAB hub.

Start Time: 5 seconds at 120 ips.

Stop Time: 5 seconds from the run mode at 120 ips.

Rewind Time: Less than 5 minutes with 1" tape, 14" reel.

Wow and Flutter:	Speed	% Flutter P/P	Bandwidth
	120 ips	0.40	0.1 cps - 10 kc
	60 ips	0.50	0.1 cps - 10 kc
	30 ips	0.60	0.1 cps - 5.0 kc
	15 ips	0.80	0.1 cps - 2.5 kc
	7-1/2 ips	1.00	0.1 cps - 1.25 kc
	3-3/4 ips	1.20	0.1 cps - 1.25 kc
	1-7/8 ips	3.00	0.1 cps - 1.25 kc

Operating Controls: Pushbutton mode controls on the transport for power, run, run-interlocked record, rewind, fast forward, ready, stop and tension release.

Two channel selectable rotary switches for playback channel selection.

Braking: Dynamic braking. Mechanical fail-safe brakes with electrical interlock.

DIRECT RECORD/REPRODUCE MONITOR SYSTEM

Frequency Response: Two nominally equalized channels, 14 track switchable, sufficient in performance to monitor for signal quality and correct overall performance of the recording system.

Tapes recorded on this portable system will exhibit the following characteristics when reproduced on equipment equal to Mincom TICOR or TIDAX line.

Speed	Frequency Response (± 3 db)	*RMS Signal to RMS Noise Ratio (db)	Reference Frequency (kc)
120 ips	400 cps to 1.5 mc	23	150
60 ips	400 cps to 750 mc	23	75
30 ips	400 cps to 375 kc	23	40
15 ips	400 cps to 187.5 kc	23	20
7-1/2 ips	400 cps to 93.75 kc	23	10
3-3/4 ips	400 cps to 46.88 kc	23	5
1-7/8 ips	400 cps to 23.44 kc	23	2.5

* Referred to reference frequency measured using 18 db/octave bandpass filter.

Input Impedance: 10,000 ohms $\pm$ 10%.

Source Impedance
Required: 91 ohms or less

Input Level: 0.35 to 5.0 volts RMS, adjustable to produce normal record level.

Output Level: 1.0 volts RMS nominal coupled into 50 ohm termination (monitor channel).

Output Impedance: 50 $\pm$ 10% ohms for reproduce monitors and record monitor.

Harmonic Distortion: 1% or less (third order) using 150 kc signal at 120 ips.

MAGNETIC HEADS

(Meet requirements of IRIG Document No. 106-60.)

Tracks: $\frac{1}{2}$ inch tape - 7 maximum
1 inch tape - 14 maximum

Gap Azimuth: Alignment of individual gaps within a head stack shall be within 1 minute of arc referenced to a straight line which is perpendicular to the direction of tape travel and in the plane of the tape. Reproduce heads adjustable within a range of $\pm 1^\circ$ nominal azimuth.

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